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(54) Title of the Invention: A Fluorescent Lamp Lighting Apparatus

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Specification

1. Title of the Invention

A Fluorescent Lamp Lighting Device

2. Claims

(1) A fluorescent lamp lighting apparatus characterized in that it is equipped with

a fluorescent lamp,

a power source apparatus for lighting that has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, that is equipped with a leakage type output transformer of which the output voltages of the aforementioned secondary coil and filament differ when loaded and unloaded, in which electric power greater than the rated electric power is supplied through the agency of the aforementioned

secondary coil and the aforementioned fluorescent lamp undergoes high output lighting and in which the filament of the aforementioned fluorescent lamp is energized by the output of the aforementioned filament coil; and

a control apparatus that has a voltage changing device that can change voltages that are impressed on the aforementioned filament and a device that detects lighting of the aforementioned fluorescent lamp, in which the voltage that is impressed on the aforementioned filament is decreased by the aforementioned voltage changing device before detection of the lighting of the aforementioned fluorescent lamp and in which it is impressed without decrease after detection of lighting.

(2) A fluorescent lamp lighting apparatus characterized in that it is equipped with

a fluorescent lamp,

a power source apparatus for lighting that has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, that is equipped with a leakage type output transformer of which the output voltages of the

a power source apparatus for lighting that has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, that is equipped with a leakage type output transformer of which the output voltages of the aforementioned secondary coil and filament differ when loaded and unloaded, in which electric power greater than the rated electric power is supplied through the agency of the aforementioned secondary coil and the aforementioned fluorescent lamp undergoes high output lighting and in which the filament of the aforementioned fluorescent lamp is energized by the output of the aforementioned filament coil; and

a constant voltage device that limits the output voltage of the aforementioned filament coil so that it does not exceed a specified set value.

aforementioned secondary coil and filament differ when loaded and unloaded, in which electric power greater than the rated electric power is supplied through the agency of the aforementioned secondary coil and the aforementioned fluorescent lamp undergoes high output lighting and in which the filament of the aforementioned fluorescent lamp is energized by the output of the aforementioned filament coil; and

a control apparatus that has a voltage changing device that can change voltages that are impressed on the aforementioned filament and a timer device, in which, when the aforementioned fluorescent lamp starts, the aforementioned timer device lowers the voltage that is impressed on the aforementioned filament until a specified time has been clocked and that impresses it without decrease after the aforementioned specified time has elapsed.

(3) A fluorescent lamp lighting apparatus characterized in that it is equipped with

a fluorescent lamp,

3. Detailed Description of the Invention

[Objective of the Invention]

(Field of Industrial Use)

This invention relates to a fluorescent lamp lighting device so that the fluorescent lamp can undergo high output lamp lighting above the rated lamp electric power.

(Prior Art)

The apparatus described in Utility Model Early Disclosure No. 60-123900 [1985] was proposed previously as an apparatus of this type. This apparatus provides high frequency electric power so that the fluorescent lamp can be lit at 1.1 to 1.30 times the nominal luminous flux.

(Problems the Invention is Intended to Solve)

It was found that there were the following problems because the electric power that is supplied to the fluorescent lamp is simply increased as described above.

In order to effect high output lamp lighting of the fluorescent lamp, heating of the filament during lamp lighting is necessary for far longer than the rated lighting time. Consequently, it is designed for a high filament heating voltage. However, when lighting of the fluorescent lamp and heating of the filament are effected using a leakage type output transformer, at the time the fluorescent lamp starts, a high starting voltage (non-load voltage) is impressed on the fluorescent lamp and starting becomes possible. On the other hand, the output voltage of the filament coil becomes higher. When this high voltage is impressed, it was found that the filament breaks. When the transformer for heating the filament is established separately from the transformer for lighting, this type of problem does not occur but the apparatus is larger and more expensive.

This invention was developed for the purpose of solving such problems of conventional apparatuses and has the objective of providing a fluorescent lamp apparatus whereby the fluorescent lamp can undergo high output lighting, breaking of the filament is prevented, life is prolonged and the apparatus is not made larger nor more expensive.

[Structure of the Invention]

(Means for Solving the Problems)

The invention described in Claim 1 (hereafter referred to as the first invention) is characterized structurally in that it has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, that is equipped with a leakage type output transformer of which the output voltages of the aforementioned secondary coil and filament differ when loaded and unloaded, in which electric power greater than the rated electric power is supplied through the agency of the aforementioned secondary coil and the aforementioned fluorescent lamp undergoes high output lighting so that the filament of the aforementioned fluorescent lamp is energized by the output of the aforementioned filament coil; and, further, in that it has a voltage changing device that can change voltages that are impressed on the aforementioned filament and a device that detects lighting of the aforementioned fluorescent lamp, by which means the voltage that is impressed on the aforementioned filament is decreased.

The invention described in Claim 2 (hereafter referred to as the second invention) is characterized structurally in that it has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, that is equipped with a leakage type output transformer of which the output voltages of the aforementioned secondary coil and filament differ when loaded and unloaded, in which electric power greater than the rated electric power is supplied through the agency of the aforementioned secondary coil and the aforementioned fluorescent lamp undergoes high output lighting so that the filament of the aforementioned fluorescent lamp is energized by the output of the aforementioned filament coil; and, further, in that it has a voltage changing device that can change voltages that are impressed on the aforementioned filament and a timer device, in that, when the aforementioned fluorescent lamp is lit, the voltage that is impressed on the aforementioned filament is decreased by the aforementioned voltage changing device until the aforementioned timer clocks a specified time and in that [voltage] is impressed without decrease after the aforementioned specified time has elapsed.

The invention described in Claim 3 (hereafter referred to as the third invention) is characterized structurally in that it has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, that is equipped with a leakage type output transformer of which the output voltages of the aforementioned secondary

coil and filament differ when loaded and unloaded, in which electric power greater than the rated electric power is supplied through the agency of the aforementioned secondary coil and the aforementioned fluorescent lamp undergoes high output lighting so that the filament of the aforementioned fluorescent lamp is energized by the output of the aforementioned filament coil; and, further, in that a constant voltage device that limits the output voltage of the aforementioned filament coil is installed so that the output voltage of the aforementioned filament coil does not exceed a specified set value.

(Action)

As indicated in the first invention, when the fluorescent lamp is lit, sufficient starting voltage is impressed on the fluorescent lamp. At this time, the output voltage of the filament coil becomes higher than during lighting (when there is a load). However, during the period up until the detection device detects lighting of the fluorescent lamp, the voltag impressed on the filament is decreased by the voltage changing device. Consequently, the filament is not broken. After lighting of the fluorescent lamp, the output voltage of the secondary coil of the output transformer decreases until it is close to the lamp voltage and the fluorescent lamp is stably lit. The output voltage of the filament coil also decreases in response to the output voltage of the secondary coil. At this time, because the voltage that is impressed on the filament is not decreased, the filament of the fluorescent lamp is suitably heated during high output lighting.

The second invention is similar to the first invention in that sufficient starting voltage can be impressed before starting the fluorescent lamp. In this invention, the timer device decreases the voltage that is impressed on the filament until a specified time is clocked. Consequently, by setting the aforementioned specified time to the required degree of time until the fluorescent lamp is lit, breaking of the filament can be prevented in the same way as in the first example. Because the voltage that is impressed on the filament is not decreased after the aforementioned timer device has clocked the specified time, the filament of the fluorescent lamp that has undergone high output lighting can be suitably heated.

The third invention is also similar to the first and second inventions in that the fluorescent lamp can be started and lit. Because the output voltage value of the filament coil is limited so that it does not exceed a specified value, by setting this specified value appropriately, the filament is not broken and heating of the filament during lighting is suitable. The third invention is advantageous in that its structure can be simplified.

In the inventions described above, the output transformer may be separate from the primary coil and the secondary coil or it may be a windings type. When it is a windings type, the supply of electric power to the fluorescent lamp through the agency of all or a part of the secondary coil and the primary coil is included in each of the aforementioned inventions. Further, either low frequency or high frequency voltage may be the voltage that is input in the primary coil side of the output transformer.

In the first invention, a means of detection such as lamp voltage, lamp current, light output or generation of heat by the structural component accompanying lighting of the fluorescent lamp can be used as the means of detecting lighting of the fluorescent lamp in the control apparatus. These specific structures are suitable for those in said technological fields.

In the second invention, electric circuits in which time constant circuits or mechanical devices are employed, they may be used as the timer device in the control apparatus. It is necessary for the timer device to be interlocked for starting of the fluorescent lamp, and, preferably, it is desirable for it to be interlocked for installation and detachment.

In the third example, the constant voltage device can be constructed, for example, of a pair of zener diodes or varistors that are connected in a series in the reverse direction to each other.

(Examples)

We shall now describe an example of the first invention by reference to Figure 1. 1 is th power source apparatus for lighting. It contains the output transformer 2 and the high frequency generation apparatus 3 that is installed on the input side of the output transformer 2. The aforementioned output transformer 2 has the primary coil 21 and the secondary coil 22 that are loosely bound to each other and the filament coils 23 and 23 that are tightly bound to the secondary coil 22. The aforementioned high frequency 5 is the control apparatus. This control apparatus has the voltage changing device 51 that changes the voltage that is impressed on the aforementioned filaments and the device 52 that detects lighting of the aforementioned fluorescent lamp 4. The detection device 52 decreases the voltage that is impressed on the filaments by the aforementioned voltage changing device 51 until lighting of the fluorescent lamp 4 is detected and impresses [voltage] without decrease after lighting of the fluorescent lamp 4 has been detected. The voltage changing device 51, which changes the voltage that is impressed on the aforementioned filaments, is comprised of the changeover switch 511, which is installed between one end of the filament coil 23 and one end of the filament, and of the impedance element 512, which can be inserted into and removed from the filament heating circuit. Further, the aforementioned detection device 52 has the rectifier 521, which is installed between the two terminals of the aforementioned secondary coil 22, the partial pressure circuit 522, which is installed between the output terminals of the rectifier 521, the relay control coil 523 and the transistor 524, which are connected in a series and which are installed between the output terminals of the aforementioned rectifier 521, and the constant voltage element 525, which is installed between the partial pressure point of the aforementioned partial pressure circuit 522 and the aforementioned transistor 524. The aforementioned control coil 523 controls changeover of the aforementioned changeover switch 511.

Next, we shall describe the action of this example. When the power source 1 for lighting is generation apparatus 3 is an inverter in which, for example, a transistor or a thyristor is used as the switching element. In this cas , the inverter may be of any form. 4 is a fluorescent lamp that is lit by the aforementioned electric power apparatus for lighting and that heats the filament. Specifically, electric power for lighting is supplied from the aforementioned secondary coil 22 and electric power for heating the filaments is supplied to each filament from the aforementioned filament coils 23 and 23.

input (for example, the high frequency generation apparatus 3 is caused to operate by a switch not shown in the figure), at the time of starting of the fluorescent lamp, a high starting voltage is impressed on the fluorescent lamp through the agency of the secondary coil 2 of the output transformer 2. Further, the output voltage of the filament coil 23 becomes higher after lighting, as will be described subsequently. However, because the partial pressure voltage of the partial pressure circuit 522 of the detection device 52 is relatively high, it is guided through the constant voltage element 525 and the transistor 524 is turned on. Consequently, a magnetic excitation current flows into the control coil 523 and the control coil 523 controls the changeover switch 511 so that impedance element 512 is inserted into the filament heating circuit. As a result, voltage of which the partial pressure has been made small is impressed by the aforementioned impedance element 512 on the filament.

By means of the aforementioned high starting voltage, when the fluorescent lamp is lit, the output voltage of the secondary coil 22 of the output transformer 2 is decreased to close to the lamp voltage, and, accompanying this, the output voltage of the filament coil 23 is also decreased. For this reason, the constant voltage element 525 of the control apparatus 5 becomes non-transmitting, the transistor 524 is turned off, the magnetic excitation current does not flow into the control coil 523, and, this time, the control coil 523 controls the changeover switch 511 so that the impedance element 512 is short-circuited. Consequently, the output voltage of the filament

coil 23, which is not under partial pressure, is impressed on the filament. The output voltage of the filament coil 23 at this time is set to a suitable value for high output lighting of the fluorescent lamp, by which means the life of the fluorescent lamp is not impaired and high output lighting is

The experimental results in this example are shown. When a 40 W fluorescent lamp (manufactured by Toshiba), for which 3.6 V was suitable as the filament heating voltage during lighting, when lighting was performed at nominal luminous flux, was lit so that it was at 1.38 times the aforementioned nominal luminous flux, it was necessary for the filament heating voltage during lighting to be approximately 4.0 V. When lighting at nominal luminous flux, the output voltage of the filament coil when not loaded was approximately 10 V. By contrast, when lighting at 1.38 times nominal luminous flux, the output voltage of the filament coil was approximately 15 V. However, this could be decreased to approximately 10 V by means of the voltage changing device, and, as a result, deterioration of the life of the fluorescent lamp could be prevented. The starting voltage of the fluorescent lamp was 380 V, the lamp voltage during lighting at nominal luminous flux was 100 V and the lamp voltage during lighting at 1.38 times [nominal luminous flux] was 80 V.

Next, we shall describe an example of the second invention by reference to Figure 2. Parts that are the same as those in Figure 1 are given the same symbols and explanations of them will be omitted. The control apparatus 6 in this example has the device 61 that changes the voltage that is impressed on the filaments and the timer device 62. At the time of starting of the fluorescent lamp, the voltage that is impressed on the filaments is decreased until the aforementioned timer device 62 clocks a specified time, and, after the aforementioned specified time has been clocked, [voltage is] impressed without decrease. The device 61 that changes the voltage that is impressed on the aforementioned filaments is of the same structure as in Figure 1. Further, the aforementioned timer device 62 contains the rectifier 621, which is installed between the two terminals of the secondary coil 22, the time constant circuit 622 that is installed between the

possible. Th leakage impedance of the output transformer 2 acts as the current limiting impedance for stable lighting of the fluorescent lamp 4.

output terminals of the rectifier 621, the transistor 623, which is installed between the output terminals of the aforementioned rectifier 622 and which controls the base in the output of the aforementioned time constant circuit and the relay control coil 624 that is installed serially with the transistor 623. This time device 62 may also be installed on the primary coil side of the output transformer. In this case, it is constructed using a component of a lower voltage than that in this example.

Next, we shall describe the action of this example. At the time of starting when the power source apparatus 1 for lighting is introduced, the output of the time constant circuit 622 of the timer device 62 in the control apparatus 6 is still small and the transistor 623 is activated. Consequently, magnetic excitation current flows into the control coil 624 and the control coil 624 controls the changeover switch 511 so that the impedance element 512 is inserted. When a specified time has elapsed after starting and the output of the time constant circuit has become large, the transistor 623 goes off and magnetic excitation current no longer flows into the control coil 624. Consequently, at the time, the changeover switch 511 is controlled so that the impedance element 512 is interposed in the filament heating circuit. Because the other actions are the same as those indicated in Figure 1, explanations of them are omitted.

Next, we shall describe an example of the third invention by reference to Figure 3. In this example, parts that are the same as those in Figure 1 are given the same symbols and explanations of them will be omitted. The constant voltage device 7 of this example is comprised of a varistor. The voltage value of the varistor is set, for example, to 10 V. Consequently, even if the output voltages of the filament coils 23 and 23 are increased at the time of starting of the fluorescent lamp, the voltage

that is impressed on the filaments is limited to 10 V. During lighting, for example, 4 volts, which is suitable for heating of th filaments, can be impressed on the filaments. B cause the other actions can easily be understood from the

Figure 4 shows another example of the constant voltage device 7. Specifically, it contains the pair of zener diodes 71 and 71that are connected to each other in the reverse direction and resistance element 72. Because the actions of this example can easily be understood, explanation is omitted here.

In the first and second examples, the means for changing the voltage that is impressed on the filaments, in addition to those in the examples described above, may be, for example, to install an intermediate tap in the filament coil and to collect the output from the entire filament coil or to extract it through the agency of the intermediate tap.

Further, in the third example, a device using a three-terminal regulator can be used as the constant voltage device.

[Effect of the Invention]

Because, as described above, the first invention has a primary coil and a secondary coil that are loosely bound to each other and a filament coil that is tightly bound to the aforementioned secondary coil, it is equipped with a leakage type output transformer of which the output voltages of the aforementioned secondary coil and filament differ when loaded and unloaded, electric power greater than the rated electric power is supplied through the agency of the aforementioned secondary coil and the aforementioned fluorescent lamp undergoes high output lighting so that the filament is heated by the output of the aforementioned filament coil and the voltage that is impressed on the filament is decreased until lighting of the aforementioned fluorescent lamp is detected, overvoltage is not applied and the filament is not broken at the time of starting and life is not impaired by impressing a suitable heating voltage during high output lighting. Because the electric power for lighting and the electric power for filament heating are supplied by a common transformer, the apparatus as a whole is not increased in size and its cost is not increased.

In the second invention, a specified time during starting of the fluorescent lamp that is set by the timer device results in decrease of the voltage that is impressed on the filaments and [voltage is] impressed after the specified time without decrease, for which reasons the same effects as in the first example as described above are displayed.

In the third example, the voltage that is impressed on the filaments is controlled by the constant voltage device so that it is above a fixed level, for which reason the same effects as in the first example as describe above are displayed.

4. Brief Explanation of the Figures

Figure 1 is a circuit diagram that shows an example of the first invention, Figure 2 is a circuit diagram that shows an example of the second invention, Figure 3 is a circuit diagram that shows an example of the third invention and Figure 4 is a circuit diagram of the essential component that similarly illustrates another example.

1 - power source apparatus for lighting
2 - output transformer
5, 6 - control apparatus
51, 61 - voltage changing device
52 - detection device; 62 - timer device
7, 7 - constant voltage device

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Figure 1

[Key to translation]:

1 – power source apparatus for lighting
2 – output transformer
5 – control apparatus

Figure 2

[Key to translation]:

6 – control apparatus

Figure 3

Figure 4